

Integrating Artificial Intelligence into the Design of Immersive Learning Environments

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ABSTRACT

The use of artificial intelligence is fundamental in immersive education environments, which focuses on the development of intelligent systems capable of learning, thinking, planning and making decisions. Objective: to capture the generalities of the use of artificial intelligence in the creation of immersive learning environments in higher education. Methodology: several databases were used to search for information on the subject, including: Scielo, Dialnet, ELSEVIER, Cochrane, Redalyc, among others, using the following descriptors: "Artificial Intelligence + higher education", "Artificial Intelligence + immersive education" and "Artificial Intelligence + immersive education + higher education", thus selecting 76 articles that met the inclusion criteria. The results are that the articles focus on the study, description, analysis and comparison, linked to the knowledge of new immersive technologies, as well as, in other cases, to the mastery of the digital competence of university professors, concluding that the use of artificial intelligence in immersive education environments in higher education offers great opportunities to improve the quality and effectiveness of teaching. It is clear that the combination of teaching methodologies and appropriate educational technologies contribute to a more enriching learning experience.

Keywords: teaching, learning, teaching techniques, artificial intelligence.

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Introduction

In today's digital age, higher education has evolved rapidly due to technological advancement and the growing demand for more dynamic and interactive learning experiences (Galindo Durán, 2020). In this context, Chicaiza et al (2023) immersive learning environments, have emerged as promising tools to transform the way students acquire knowledge and skills. However, the real revolution in this field has been the integration of artificial intelligence (AI) into the design of these environments, which has taken immersive education to a new level of personalization and efficiency.

In recent years, technology has transformed the way in which teaching and learning is done today, however, education has evolved to incorporate an emerging disruptive technology: Artificial Intelligence (hereinafter AI), understood as "a field of study that combines the applications of machine learning, algorithm production and natural language processing" (A'mar & Eleyan, 2021). Therefore, it is crucial to adapt to these changes in the educational field and consider how AI can be effectively integrated into education. A clear example of the inclusion of AI is that caused by ChatGPT (Jiménez García, Orenes Martínez, & López Fraile, 2024);

(García Peñalvo, Llorens Largo, & Vidal, 2024), but recent studies highlight that, if it is used appropriately, it can maximize teaching and learning (UNESCO, 2021); (Baidoo Anu & Owusu Ansah, 2023).

Artificial intelligence refers to the ability of machines to simulate and emulate human cognitive processes, such as learning, perception, and decision-making (Ruiz Muñoz & Yépez González, 2024). By combining AI with immersive learning environments, a unique symbiosis is achieved that expands educational possibilities and transforms the way students interact with content and study materials (Lameras & Sylvester, 2021). In this scientific paper, we will explore in depth the integration of artificial intelligence in the design of immersive learning environments and how it improves the personalization of learning, adapting to the individual learning needs and styles of students. However, these technologies have been adapted in various ways in higher education, one of the most revolutionary being immersive education. According to the Royal Spanish Academy - RAE, (2024), the term "immersive" refers to the fact that it makes the viewer experience a virtual reality as if it were authentic. Prince Torres (2022).

Materials and Methods

This research focused on a bibliographic documentary review methodology, where various databases were used to search for information related to the investigated topic, among which are: Scielo, Dialnet, ELSEVIER, Cochrane, Redalyc, among others. A random and consecutive search was carried out, using the following descriptors: "Artificial Intelligence + higher education", "Artificial Intelligence + immersive education" and "Artificial Intelligence + immersive education + higher education". The results found were selected according to criteria of the Spanish and English language, relevance, thematic correlation and date of publication in the last five years, dispensing with a few records of previous data, but with current and relevant content for the present research. The bibliographic material collected consisted of scientific articles, in general, clinical guidelines, e-books, clinical trials, consensus, protocols, postgraduate and doctoral theses, scientific news, bulletins and/or brochures from official or private institutions with a recognized trajectory in the scientific-academic field and other information, considered of interest and with value of scientific evidence at the discretion of the authors.

Table 1. *Criteria Applied for the selection of documents*

Criteria	Inclusion	Exclusion
Typology Availability	Scientific articles Open access and full text	Book chapters, conference proceedings Paid, summary only, or no full-text access
Type of study	Applied research	Review articles, theoretical, unimplemented designs, instrument validation and training
Participants	University Education Faculty	Teachers or students from other stages
Publication date	2019-2024	Anterior a 2019
Language	Spanish and English	Other languages

Development

Learning environments

In this sense, immersive education refers to the creation of learning environments that completely envelop the student, generating an unforgettable experience.

Practical and highly interactive, enhanced through the use of:

Augmented reality: According to Montenegro and Fernández (2022), it is a technology that "integrates signals captured from the real world with signals generated by computers, makes them correspond in the construction of new coherent realities, which complement and coexist in the real world and the virtual world, enriching cognitive experiences" (p. 3), which makes a correspondence between the artificial world and the experiences of the tangible environment. For their part, Martínez, Fernández, and Barroso (2021) state that augmented reality is useful when it comes to arousing interest in courses that are facilitated and in the same way, it helps to focus attention on the aspects unraveled in classes.

Virtual reality: Menjívar Valencia (2021) establishes that it is "an advanced user interface, whose

characteristics involve visualization and movement in three-dimensional environments and interaction with elements in said environment" (p. 86) with which the conversion of educational models is promoted, studying with particularity each case where it can be applied.

3. *Mixed reality*: Regarding mixed reality, De Jesús and Ayala (2021) clarifies that it combines augmented reality, holographs, artificial intelligence, a data storage that can become infinite in the cloud and all in an environment that never ceases to be physical and real, so it represents a fusion of virtual reality and augmented reality. Similarly, Alonso et al. (2024) emphasize that this conjunction of elements allows the promotion of both practical and theoretical learning.
4. *3D immersive learning*: It is also a context referred to as the metaverse or virtual world, which according to Ayala et, al (2020) is a persistent representation that offers the possibility of synchronous interaction between users and between them and the world, within a space designed in the form of a universe navigates and thus, it is also a way of representing reality so that future problems that are observed within tangible environments are addressed.

Innovative pedagogical methodologies powered by artificial intelligence

The merging of education with artificial intelligence has given rise to a transformative educational landscape, in which pedagogical methodologies have been revitalized through the incorporation of advanced technologies. One of the most outstanding advances in this regard is the integration of artificial intelligence in online learning environments. Online education platforms, powered by AI algorithms, analyze student performance and provide personalized recommendations for study, identifying areas of difficulty and suggesting specific resources to address them. This enables a student-centred approach, in which each individual can progress at their own pace and receive the necessary support (Ayuso del Puerto & Gutiérrez Esteban, 2022); (Sekeroglu, Dimililer, & Tuncal, 2019).

Table 2. *Classification of Generative AI Tools with Potential Educational Use*

Text generation	Research support	ChatPDF, Consensus, Elicit, Chatbot
	Content creation	Humata, Klavier, SciSpace Copilot, Scite Assistant,
	Language	Trinka

	Teaching Personal Resume Builder Exam Generator Office tools Search Engine Text Paraphrasing	ChatGPT, ChatSonic, Claude Jasper, Notion Twee Resume Builder Conker. Monic Google Workspace, Microsoft 365 Copilot Microsoft Bing, Perplexity, You
Imaging	Graph generation Imaging	Quillbot GraphGPT Adobe Firefly Bing Image Creator, Craiyon, DALL·E 2, Deep Dream Generator, Dream by Wombo, Leap, Midjourney, NightCafe, Stable Diffusion Online, Starryai, Stockimg, Visual ChatGPT
Presentation generation	Generation of Presentations	ChatBA, Decktop us, GPT for Slides, SlidesAI, Gamma
Video Generation	Video to Text Converter Video generation	YoutubeDigest Fliki, Gencraft, Video Image, Make a video
Generation of 3D objects	Generating 3D objects	AICommand, DreamFu sion, GET3D,
Generation of audio	Speech-to-text converter Audio Generation Voice modulator	Imagine 3D Otter, Transkriptor AudioLM, Lovo, Murf.ai, Voicemaker Voicemod
Source code generation	Debugging Code	Adrenaline, Code GPT

	Code generation	Amazon CodeWhisperer, Codeium, Ghostwriter, Github copilot, Text2SQL
AI-generated text detection	Anti-plagiarism: detection of AI-generated texts	Turnitin AI Text Classifier, GPTZero

It is essential to highlight that while AI presents ample opportunities for education, it is not a global solution to all educational problems. Therefore, it is essential to use it consciously and thoughtfully, appropriate to the specific educational context, to maximize its potential benefits (Mulders, Buchner, & Kerres, 2020). Consequently, it is necessary to carry out a critical and rigorous reflection to ensure the effectiveness and responsibility in the use of AI in education. In this sense, teachers have a fundamental role in the integration of AI in education. Korhonen et, al (2022) argues that teachers must have specific knowledge in technology and pedagogy related to AI to effectively integrate it into education. In addition, they must have an ethical understanding to evaluate AI-based decisions and ensure that they are used responsibly and equitably.

This idea was already worked on by Carrington (2016), when he designed the Padagogy Wheel for the integration of technology, which is a tool designed to help teachers integrate technology into their pedagogical practices, focusing on pedagogy rather than technological applications. The reason why this wheel is a tool to improve the design and assessment of student-centered learning is because each section of the wheel interconnects with the other sections, which means that learning is not a linear process, but is an ever-evolving process.

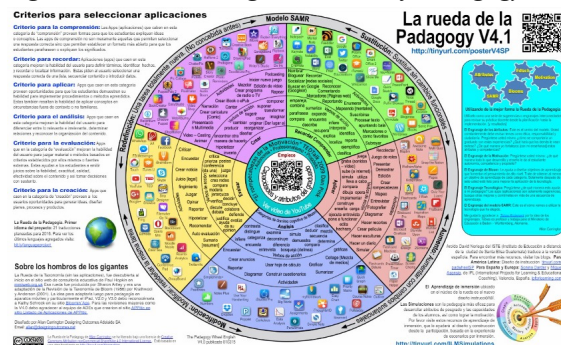
In this sense, Allan Carrington's Wheel of Pedagogy consists of several concentric rings:

- 1) Central ring presenting the six cognitive levels of Bloom's Taxonomy
- 2) Ring with the four degrees of technological integration according to the SAMR Model
- 3) Outer rings containing examples of technological tools and applications that can be used at each cognitive and technological integration level. Based on these ideas, Carrington's Pedagogical

Wheel (2017) combines the two theoretical frameworks mentioned above (Bloom's Taxonomy and SAMR Model) into a visual representation (see Figure 1) that facilitates the selection of appropriate technological tools and strategies for each level of cognitive ability and technological integration.

Allan Carrington's Wheel of Pedagogy has proven to be an effective tool for improving the quality of teaching (Cabrera Leonardini, 2021) and learning in the context of technology. However, the wheel does not consider AI as a technology that can be integrated into teaching and learning. For this reason, and in view of the changes that AI is causing in the field of education, the effective integration of AI in education at any stage is becoming increasingly facilitated, thus transforming education by substantially improving it, as long as it is used responsibly and consciously (Pombo, 2023).

Figure 1. Allan Carrington's Wheel of Pedagogy



Fuente: Carrington (2017). <https://designingoutcomes.com/assets/Padagogy Wheel Translations/Padagogy Wheel V4 SPANISHv1 HD.pdf>

For this reason, the creation of a Pedagogy Wheel for AI, such as Allan Carrington's proposal in his original model, is crucial to take advantage of the advantages of this emerging technology in the teaching and learning process, since facilitates the selection of AI technology tools and strategies suitable for each level of cognitive skill and AI technology integration.

Table 3. Bloom's Taxonomy for Artificial Intelligence

	Descrip tion	Descrip tion applied to AI	Examples with AI
Levels of	Remember	At this level, the student should	Teaching process: AI can be used to create question-

	the ability to identify patterns, detect errors, and evaluate logic	large data sets.	analyze large data sets or to identify patterns in complex information.
Evaluate	At this level, the student must be able to make judgments and Critical reviews on information. This implies the ability to compare and to contrast, judge and evaluate the quality of the information	At this level, AI can help students assess their own learning and progress through the use of feedback and assessment systems	Teaching Process: AI Can Be Used to Create Automated assessment systems that provide instant feedback to students and teachers on student performance. Process of learning: The students use AI tools to self-assess and receive feedback on their own performance
Create	At this level, the student should be able to use the information	At this level, AI can help students create original content by using	Teaching process: AI can be used to create immersive and personalized learning environments that

	gained to create something new. This implies the Ability to generate new ideas, design creative solutions to problems and create unique products	tools of generation of content	allow students to create original content and express their creativity. Learning process: Students use AI tools to create multimedia content or to develop innovative solutions to complex problems.
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Building meaningful connections through artificial intelligence

In order to be able to use a technology in the teaching and learning processes judiciously and knowledgeably, its possibilities and limits must first be known without being carried away by extremism, which is usually particularly biased when a potentially disruptive trend makes its appearance, as has happened with generative AI, whose penetration has been particularly accelerated. Therefore, before sharing reflections on the implications of this technology in the educational context, a prospective study will be carried out aimed at both the tools that are already available with a potential educational use, as well as the contributions that have been made from academia in the first six months since the tsunami caused by ChatGPT.

Advantages and challenges of integrating artificial intelligence in education

Two forces converge in the world of education. The world is advancing at a rapid pace with technology at hand. On the other hand, we see classical methods and stagnant educational systems. AI takes its place and shows us a firmer step towards the future of education, as it not only improves efficiency, but also redefines the way we conceive education. From facilitating teaching to promoting equality and inclusion, the benefits are as tangible as they are transformative.

- *Makes teaching easier:* Teachers can use AI to automate administrative tasks, freeing them up to focus on teaching. Personal interaction becomes the main focus.
- *Stimulates individual and group learning:* Smart tutoring systems can adapt to each student's learning needs, promoting more effective, personalized, and engaging learning.
- *Enables student monitoring:* Applications of artificial intelligence and AI algorithms can track student performance in real-time, providing immediate feedback that can improve information understanding and retention.
- *Simplifies education management:* AI can improve the efficiency of administrative and management tasks in schools, from scheduling classes to managing grades.
- *Promotes equality and inclusion:* AI systems can adapt to the needs of all students, regardless of their level of ability, background or physical or intellectual capacities, thus having a positive impact of artificial intelligence on educational equality.
- *Combats school dropout:* AI can identify students at risk of dropping out of school and provide early interventions, contributing to improvements in academic performance and the success of each study program.
- *Include smart tutoring systems:* Smart tutoring systems can provide personalized assistance to students, adapting to their pace and learning style. This not only complements the teacher's work, but also offers a more individualized approach.
- *Apply remote assessments:* With AI supporting remote assessments, flexibility in the educational process is promoted. Students can be assessed more effectively, and results can be analyzed quickly and accurately.
- *Implement online learning systems:* AI can enrich the learning experience in virtual environments, adapting to students' individual preferences and abilities. This makes learning more interactive and personalized.
- *Collecting and analyzing school data:* AI can collect and analyze education data to identify patterns, trends, and areas for improvement.
- *Create personalized learning content:* AI can generate educational content tailored to each student's specific needs. This goes beyond superficial personalization, offering a truly adaptive curriculum that helps drive educational innovation.

Ethical Challenges and Considerations

That is the other side of the coin, and what makes it important to address technological tools with a responsible perspective and in line with the central educational policies of our century. To name a few, these are the challenges in the educational field:

Lack of real personalization: Although AI in education aims to adapt to the individual needs of students, there is a risk that personalization is superficial and does not adequately reflect the complexities of each student's learning process.

Equity: AI can perpetuate or even exacerbate existing inequalities in the education system. For example, AI algorithms may be biased or students with limited access to technology may be left behind.

Privacy and security: The collection and use of personal data in educational settings through AI can raise concerns about the privacy and security of student information. It is essential to ensure robust measures to protect sensitive information, including when interacting with technologies such as ChatGPT. For more information, it is recommended to review this publication.

Technological dependency: The use of artificial intelligence, robotics, and the multiple technological facilities of our times can make students and educators less dependent on important human skills, such as decision-making, critical thinking, and problem-solving.

Content quality: AI is only as good as the data provided to it. If the educational content is of low quality, student learning will suffer.

Results

Starting from the fact that a systematic review requires having defined a prior action protocol that must be documented, the PRISMA framework, an acronym for Preferred Reporting Items for Systematic Reviews and Meta-Analyses, is one of the most widely used in systematic review articles, providing a framework that "helps authors who intend to improve the information in systematic reviews and meta-analyses" (García Peñalvoa, 2020). Figure 2 shows the process followed for the selection of the articles that make up this analysis. In this case, the phases of the Prism Framework are followed, as a tool that contributes to improving clarity and transparency in the publications of systematic reviews.

Figure No. 2. *Flow chart of the item selection process.*



As can be seen, a total of 169 results were obtained in the initial search. After the application of the inclusion criteria set out, the documents were reduced to 114 texts, 88 full-text documents were analysed because they met the predefined inclusion criteria, but once fully evaluated, and verified by reverse search, that in the bibliography of the primary documents retrieved in the search, no other source was identified that met the proposed inclusion criteria. The 76 articles were included for this bibliographic review.

Analyzing the 76 selected articles, it was verified that:

- It observes that 21 of the works carried out in the contexts of universities with headquarters in Spanish territory, while there are 55 articles that have samples of professors from other university institutions, coming from Argentina, Colombia, Venezuela, Mexico, Nicaragua, Peru, Brazil and Chile.
- Three major trends can be observed in terms of the objectives set by the different researchers. Firstly, articles that focus on study, description, analysis and comparison, linked to knowledge, both of new immersive technologies, as well as, in other cases, to the mastery of the digital competence of university teaching staff.
- On the other hand, the second trend observed in the studies is the one that looks beyond the level or domain of teachers' digital competence, and fundamentally integrates and analyzes variables such as the predisposition towards the use of ICTs, and/or the beliefs associated with the use of digital technologies in teaching tasks.
- Undoubtedly, the shift to remote teaching allowed and encouraged flexibility and creativity, providing an opportunity to reflect on what university teachers do and how improvement could be achieved.
- In any case, the realization of this study allows us to situate the state of the art based on scientific evidence, which we believe will enable not only reflections that motivate the improvement of institutional policies in the field of teacher training but also in terms of educational innovation. We believe that integrating teaching methodologies and educational technologies, without forgetting the importance of carrying out a prior and competency-based analysis, which allows the identification of sociodemographic and digital variables that may be conditioning the teaching-learning process, can be a

good starting point.

Finally, and although the realization of this work is limited to studies published only in the Scopus, Scielo, Latindex databases and that the progressive trend of publications related to the subject, leads to a relative obsolescence, after the completion of this work, the identification of training itineraries that work from the real training needs of university teachers are proposed as lines of future research, with special emphasis on areas of competence that require not only a response from teachers but, especially, that involve responsible, critical and creative use of tools by students.

Conclusions

the integration of artificial intelligence (AI) into the design of immersive learning environments has the potential to significantly transform the way people acquire knowledge and skills. By combining AI with virtual reality, augmented reality, and other immersive technologies, highly interactive and personalized learning experiences can be created. In addition, AI can simulate realistic and complex scenarios in virtual environments, giving students the opportunity to apply their knowledge in hands-on situations without risk. However, it is important to note that the integration of AI into immersive learning environments also poses challenges and ethical considerations. The collection and use of personal data should be approached with caution to ensure the privacy and security of students.

Conflict of Interest

The authors declare that this study does not present conflicts of interest and, therefore, the processes adapted by this journal have been ethically followed, stating that this work has not been published in another journal partially or totally.

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